CLAIMS

What is claimed is:

1. A method for generating a motor drive signal comprising:

obtaining compensator current and compensator voltage measurements;

receiving a pulsed motor drive signal;

generating compensator reference values; and

controllably adjusting a compensator current source and a compensator voltage source in response to the compensator current and compensator voltage measurements and the compensator reference values in order to generate a compensator motor drive signal.

2. A method of compensating a motor drive signal comprising:

obtaining compensator current and compensator voltage measurements;

receiving a motor drive signal;

generating compensator reference values; and

controllably adjusting a compensator current source and a compensator voltage source in response to the compensator current and compensator voltage measurements and the compensator reference values in order to modify the motor drive signal, thereby providing a compensator motor drive signal.

3. The method of claim 2, wherein the step of generating compensator reference values comprises generating a reference current waveform and a reference voltage waveform.

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300 South Wacker Drive, 32nd Floor
Chicago, IL 60606
(312) 913-0001

4. The method of claim 3, wherein the reference current waveform and a reference voltage waveform are determined in part by a characteristic line impedance and a propagation delay parameter.

5. The method of claim 4, wherein the characteristic line impedance is estimated in response to material properties of a transmission line.

6. The method of claim 4, wherein the propagation delay parameter is estimated in response to material properties of a transmission line.

7. The method of claim 4, wherein the propagation delay parameter is estimated in response to propagation delay measurements.

8. The method of claim 3, wherein the reference current waveform and the reference voltage waveform are continuous-time signals.

9. The method of claim 3, wherein the reference current waveform and the reference voltage waveform are discrete-time signals.

10. The method of claim 9, wherein the reference current waveform and the reference voltage waveforms are stored in a memory device.

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11. The method of claim 2, wherein the step of obtaining compensator current and compensator voltage measurements comprises measuring a compensator input voltage and compensator output current.

12. The method of claim 11, wherein the measurements are analog signals.

13. The method of claim 11, wherein the measurements are discrete time signals.

14. The method of claim 2, wherein the compensator current source is a parallel active filter and the compensator voltage source is a series active filter.

15. The method of claim 14, wherein the parallel active filter and series active filter are controlled by a pulse controller.

16. The method of claim 15, wherein the pulse controller is a pulse width modulation controller.

17. The method of claim 2, wherein the step of controllably adjusting a compensator current source and a compensator voltage source comprises using the compensator current and compensator voltage measurements and the compensator reference values to compute waveform error signals and controllably adjusting the compensator current source and the compensator voltage source in response to the waveform error signals.

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18. The method of claim 2, wherein the step of controllably adjusting a compensator current source and a compensator voltage source is performed by a microcontroller.

19. The method of claim 2, wherein the step of controllably adjusting a compensator current source and a compensator voltage source is performed using analog controllers.

20. The method of claim 19, wherein the analog controllers are propositional integral derivative (PID) controllers.

21. The method of claim 19, wherein the analog controllers are propositional integral (PI) controllers.

22. A method for adaptively compensating a motor drive signal generated by an actuator for transmission to a motor over a transmission line, the method comprising:

a) measuring a motor drive signal received at the motor;

b) determining a propagation delay of signals transmitted from the actuator to the motor;

c) estimating a characteristic impedance of the transmission line using the propagation delay and the measured motor drive signal;

d) generating a compensated motor drive signal based on the estimated characteristic impedance of the transmission line;

e) measuring a value of the compensated motor drive signal received at the motor;

f) determining whether the measured value of the compensated motor drive signal received at the motor is within a threshold error level; and

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g) based on the determination, repeating steps b) to f) until the measured value of the compensated motor drive signal is within the threshold error level.

23. The method of claim 22, wherein the motor drive signal received at the motor is selected from the group consisting of a current drive signal and a voltage drive signal.

24. The method of claim 22, wherein determining the propagation delay of signals transmitted from the actuator to the motor comprises determining the propagation delay of the transmission line based on a value of a characteristic impedance of the transmission line.

25. A system for providing a drive signal via a transmission line, the system comprising:

a voltage source for generating a voltage reference value;

a current source for generating a current reference value; and

a processor operable to measure an output current of the system and a voltage across the current source, and based on a characteristic impedance of the transmission line, a length of the transmission line, the voltage reference value and the current reference value, and the measured output current and the measured voltage across the current source to adjust the current source and the voltage source in order to generate a drive signal for transmission over the transmission line.

26. The system of claim 25, wherein the processor provides the compensated drive signal based on the following relation:

$$\begin{bmatrix} \tilde{i}(t) \\ v(t,0) \end{bmatrix} = \frac{1}{1+e^{-2ds}} \begin{bmatrix} \frac{1}{Z_0}\left(1-e^{-2ds}\right) & -2 \\ -2e^{-2ds} & -Z_0\left(1-e^{-2ds}\right) \end{bmatrix} \begin{bmatrix} \tilde{v}(t) \\ i(t,0) \end{bmatrix},$$

where Z_0 is a transmission line characteristic impedance, d is a propagation delay of the transmission line, $\tilde{v}(t)$ is the voltage across the current source, $\tilde{i}(t)$ is the current reference value, $v(t,0)$ is the voltage reference value, and $i(t,0)$ is the measured output current.

27. The system of claim 25, wherein the current source is a parallel active filter.

28. The system of claim 25, wherein the voltage source is a series active filter.

29. The system of claim 25, wherein the system is a hybrid filter.

30. The system of claim 25, wherein the system is a back–to–back rectifier–inverter.

31. The system of claim 25, wherein the system is selected from the group consisted of a compensator, a motor, and a pulse generator.

32. The system of claim 25, wherein the processor is selected from the group consisting of a pulse controller, a pulse width modulation controller, and a pulse frequency modulation controller.

33. A system comprising:

a pulse generator;

a compensator coupled to the pulse generator, where the compensator receives a pulse generated by the pulse generator and applies a linear combination of controlled voltages and currents to the pulse to generate a modified pulse; and

a motor coupled through a transmission line to the compensator, where the motor receives the modified pulse from the compensator.

34. The system of claim 33, wherein the system operates according to the following relationship:

$$\begin{bmatrix} \tilde{i}(t) \\ v(t,0) \end{bmatrix} = \frac{1}{1+e^{-2ds}} \begin{bmatrix} \frac{1}{Z_0}\left(1-e^{-2ds}\right) & -2 \\ -2e^{-2ds} & -Z_0\left(1-e^{-2ds}\right) \end{bmatrix} \begin{bmatrix} \tilde{v}(t) \\ i(t,0) \end{bmatrix},$$

where Z_0 is a transmission line characteristic impedance, d is a propagation delay of the transmission line, $\tilde{v}(t)$ is a line voltage at the pulse generator, $\tilde{i}(t)$ is a line current at the pulse generator, and $v(t,0)$ and $i(t,0)$ are a line voltage and a line current at a beginning of the transmission line.

35. The system of claim 33, wherein the pulse generator is a pulse wave modulated (PWM) inverter.

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300 South Wacker Drive, 32nd Floor
Chicago, IL 60606
(312) 913-0001